NASA Carbon Monitoring System (CMS)
Short Data & Products Fact Sheet
for 2012, 2013, and 2014 Projects

[ABRIDGED VERSION, see Full Fact Sheet for comprehensive information]

Listed first in the order of the most recent award year (2014) to the least recent award year (2012), then listed alphabetically according to PI's last name

Project ID / Award Year / Title	Objectives	Products	Spatial Extent	Time Period	Spatial Resolution	Temporal Frequency	Application Areas	Potential Users
Andrews-03 [2014] Regional Inverse Modeling in North and South America for the NASA Carbon Monitoring System	- Quantify fluxes at scales relevant for MRV using strategies that incorporate diverse carbon dioxide observations.	**Measurement sampling footprints**	North and South Americas	2007-2010; 1 July - 20 August 2012; 2015	1° latitude x 1° longitude; 0.1° latitude x 0.1° longitude for subdomain centered on measurement location	Hourly	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project, other atmospheric transport modelers and inverse modelers
Andrews-03 [2014] Regional Inverse Modeling in North and South America for the NASA Carbon Monitoring System	- Quantify fluxes at scales relevant for MRV using strategies that incorporate diverse carbon dioxide observations.	**CO2 flux estimates.**	North and South Americas	2007-2010; 1 July - 20 August 2012; 2015	1° latitude x 1° longitude	3-hourly (will be aggregated to coarser resolution for reporting)	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project
Andrews-03 [2014] Regional Inverse Modeling in North and South America for the NASA Carbon Monitoring System	- Quantify uncertainties of CMS products.	**Uncertainty evaluations of CMS products.**	North and South Americas	2007-2010; 1 July - 20 August 2012; 2015	1° latitude x 1° longitude	3-hourly (will be aggregated to coarser resolution for reporting)	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project
Baker-01 [2014] A Global High-Resolution Atmospheric Data Assimilation System for Carbon Flux Monitoring and Verification	- Provide carbon flux estimates at sub-degree resolution using a new inversion method.	**CO2 flux estimates.**	Global	2012-2016	2/3° x 5/6° (lat/lon)	Hourly, daily, weekly	- MRV - GHG emissions inventory - Global carbon budget calculations - Land management	CMS flux teams, NOAA Carbon Tracker, EPA, DOE, Group on Earth Observations (GEO)
Baker-01 [2014] A Global High-Resolution Atmospheric Data Assimilation System for Carbon Flux Monitoring and Verification	- Quantify carbon flux uncertainties at sub-degree resolution by producing a high-rank covariance matrix.	**CO2 flux estimate uncertainties.**	Global	2012-2016	2/3° x 5/6° (lat/lon)	Hourly, daily, weekly	- MRV - GHG emissions inventory - Global carbon budget calculations - Land management	CMS flux teams, NOAA Carbon Tracker, EPA, DOE, Group on Earth Observations (GEO)
Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	- Develop a comprehensive ("big-picture") framework that incorporates all anthropogenic, terrestrial, oceanic, and atmospheric fluxes. - Provide observationally-constrained, and spatially-explicit "bottom-up" estimates of global carbon cycle fluxes using the CMS-Flux system balanced against the observed atmospheric growth rate from 2010-2015. - Attribute the variability of atmospheric CO2 to spatially-resolved fluxes from 2010-2015. - Using CO measurements, relate carbon fluxes to combustion sources.	**Total carbon fluxes**	Global	2010-2011 (2010-2015 anticipated)	4° x 5°	Monthly	- GHG emissions inventory - Land management - Global carbon budget calculations	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups

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Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	- Provide observationally-constrained, and spatially-explicit "bottom-up" estimates of global oceanic carbon fluxes using the CMS-Flux system balanced against the observed atmospheric growth rate from 2010-2015.	**Oceanic carbon (pCO2) fluxes**	Global	2010-2015	18 km	3-hourly	- Ocean acidification mitigation - Land management (riverine export)	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	- Provide observationally-constrained, and spatially-explicit "bottom-up" estimates of global terrestrial ecosystem carbon fluxes using the CMS-Flux system balanced against the observed atmospheric growth rate from 2010-2015.	**Terrestrial carbon fluxes**	Global	2010-2015	0.5°	3-hourly	- GHG emissions inventory - Land management - Global carbon budget calculations	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	- Provide observationally-constrained, and spatially-explicit "bottom-up" estimates of global terrestrial ecosystem carbon fluxes using the CMS-Flux system balanced against the observed atmospheric growth rate from 2010-2015.	**Anthropogenic carbon fluxes**	Global	1997-2015	0.1°	Hourly	- GHG emissions inventory	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	- Quantify uncertainties.	**Associated uncertainties.**	Global	2010-2015	4° x 5°	Monthly	- Global carbon budget calculations	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-02 [2014] Continuation of the CMS-Flux Pilot Project	Provide observationally-constrained and spatially explicit estimates of the uncertainty in estimates of fossil-fuel CO_2 emissions. Provide a comparison of existing gridded data products.	**Spatially explicit measure of uncertainty in fossil-fuel emissions. Compatible data file on existing gridded data**	U.S. as a test case, eventually global	2010-2015	Resolution as desired, but focused on 0.1 and 1.0 degrees	Annually, finer resolution as emissions estimates become available	- GHG emissions inventory	Climate and Earth Science modeling groups, CO2 emissions estimators, ***Gurney, Oda, Andres***
Fatoyinbo-01 [2014] Total Carbon Estimation in African Mangroves and Coastal Wetlands in Preparation for REDD and Blue Carbon Credits	- Develop a Mangrove Total Carbon Monitoring System in Gabon, Tanzania, and Mozambique. - Provide estimates of forest biomass using a suite of COTS datasets.	**Mangrove forest biomass estimates.**	Gabon, Tanzania, and Mozambique	1990-2015	12 m	Single Product 2013/2014	- MRV, REDD+ - Forest inventory - Land management - Watershed protection plans	Forestry departments of Gabon, Tanzania, and Mozambique, **WWF** ***Aurelie Shapiro***, USAID, **USFS**, **Conservation International *Emily Pidgeon*, UNEP-WCMC, University Eduardo Mondlane**
Fatoyinbo-01 [2014] Total Carbon Estimation in African Mangroves and Coastal Wetlands in Preparation for REDD and Blue Carbon Credits	- Provide mangrove forest extent maps using a suite of COTS datasets.	**Mangrove forest extent maps.**	Gabon, Tanzania, and Mozambique	1990-2015	30 m	Single Product 2013/2014	- MRV, REDD+ - Forest inventory - Land management - Watershed protection plans	Forestry departments of Gabon, Tanzania, and Mozambique, **WWF** ***Aurelie Shapiro***, USAID, **USFS**, **Conservation International *Emily Pidgeon*, UNEP-WCMC, University Eduardo Mondlane**
Fatoyinbo-01 [2014] Total Carbon Estimation in African Mangroves and Coastal Wetlands in Preparation for REDD and Blue Carbon Credits	- Develop a time series of mangrove change in all three countries from 1990 to present day.	**Mangrove forest cover change maps.**	Gabon, Tanzania, and Mozambique	1990-2015	30 m	Annually 1990-2014	- MRV, REDD+ - Forest inventory - Land management - Watershed protection plans	Forestry departments of Gabon, Tanzania, and Mozambique, **WWF** ***Aurelie Shapiro***, USAID, **USFS**, **Conservation International *Emily Pidgeon*, UNEP-WCMC, University Eduardo Mondlane**
Ganguly-01 [2014] Reducing Uncertainties in Satellite-Derived Forest Aboveground Biomass Estimates Using a High Resolution Forest Cover Map	- Provide tree cover estimate for the continental U.S. - Reduce uncertainties in the aboveground (AGB) biomass estimation.	**Tree cover maps.**	CONUS	2010-2012	1 m	Yearly	- Forest inventory - Land management, Fire Management, Land Cover Change	CMS land biomass product developers, USFS

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Ganguly-01 [2014] Reducing Uncertainties in Satellite-Derived Forest Aboveground Biomass Estimates Using a High Resolution Forest Cover Map	- Provide aboveground biomass estimates. - Compare differences between pixel-level AGB density and total AGB at aggregated scales like ecoregions and counties.	**Aboveground biomass at Landsat scale and Lidar-derived biomass maps.**	CONUS	2000-2012	30 m	Yearly	- Forest inventory - Land management, Fire Management	CMS land biomass product developers, USFS
Greenberg-01 [2014] Reducing Uncertainties in Estimating California's Forest Carbon Stocks	- Create a prototype carbon monitoring system for the state of California.	**Mean tree-sequestered aboveground biomass estimates.**	California	2005-2015	30 m	Mixture: Lidar and WV-2, 1-off; Landsat: 16 day	- Fire management - Forest inventory - Land management	**USDA FS *Carlos Ramirez***
Greenberg-01 [2014] Reducing Uncertainties in Estimating California's Forest Carbon Stocks	- Quantify uncertainties.	**Spatially explicit uncertainties.**	California	2005-2015	30 m	Mixture: Lidar and WV-2, 1-off; Landsat: 16 day	- Fire management - Forest inventory - Land management	**USDA FS *Carlos Ramirez***
Hudak-01 [2014] Prototyping a Methodology to Develop Regional-Scale Forest Aboveground Biomass Carbon Maps Predicted from Landsat Time Series, Trained from Field and Lidar Data Collections, and Independently Validated with FIA Data	- Develop a prototype carbon monitoring system for northwestern USA that can be replicated and applied in other parts of the U.S. and internationally.	**Aboveground biomass maps.**	Northwestern U.S. (from temperate rainforest to cold desert)	2002-2012	30 m nominally, 90 m means and standard deviations	Annual	- MRV - Forest inventory - Land management	Private and public forest managers (i.e. USFS), carbon assessors
Hudak-01 [2014] Prototyping a Methodology to Develop Regional-Scale Forest Aboveground Biomass Carbon Maps Predicted from Landsat Time Series, Trained from Field and Lidar Data Collections, and Independently Validated with FIA Data	- Maintain a transparent record of bias corrections at the county level.	**Estimates of bias between biomass predictions and FIA observations summarized for the representative vegetation types.**	Northwestern U.S. (from temperate rainforest to cold desert)	2002-2012	county	Annual	- MRV - Forest inventory - Land management	Private and public forest managers (i.e. USFS), carbon assessors
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and Deployment	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling linked with existing field observation systems such as the USFS Forest Inventory.	**Canopy height and forest/non-forest maps.**	Pennsylvania, Delaware, and Maryland	Variable based on Lidar acquisition dates (2004-2015)	1 m and 30 m	Once	- MRV - Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, Delaware DNR, Pennsylvania DNR, DOE, EPA, REGGI, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and Deployment	- Provide wall-to-wall, high-resolution estimates of carbon stocks and their uncertainties. - Develop and test methods for monitoring changes in carbon stocks through time using repeat Lidar data, satellite imagery, and forest inventory data, and remote sensing driven mechanistic modeling.	**Aboveground biomass with associated uncertainty maps.**	Pennsylvania, Delaware, and Maryland	Variable based on Lidar acquisition dates (2004-2015)	30 m	Once	- MRV - Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, Delaware DNR, Pennsylvania DNR, DOE, EPA, REGGI, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and	- Initialize and run a prognostic ecosystem model for carbon at high-spatial resolution over multiple eastern states.	**Prognostic ecosystem model (ED) based maps of carbon stocks and flux.**	Pennsylvania, Delaware, and Maryland	Variable based on Lidar acquisition dates (2004-2015)	90 m	Once	- MRV - Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, Delaware DNR, Pennsylvania DNR, DOE, EPA, REGGI, private landowners, **county GIS departments**, national and global entities that want to validate top

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Deployment								down products
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and Deployment	- Predict carbon sequestration potential under land use and climate change scenarios using ecosystem modeling (ED).	**ED based maps of carbon sequestration potential.**	Pennsylvania, Delaware, and Maryland	Variable based on Lidar acquisition dates (2004-2015)	90 m	Once	- MRV - Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, Delaware DNR, Pennsylvania DNR, DOE, EPA, REGGI, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and Deployment	- Produce mapped changes in above ground biomass for Maryland	**Maps of aboveground biomass change**	Maryland	Variable based on Lidar acquisition dates (2004-2015)	30 m	Once	- MRV - Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, Delaware DNR, Pennsylvania DNR, DOE, EPA, REGGI, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Hurtt-03 [2014] High Resolution Carbon Monitoring and Modeling: Continuing Prototype Development and Deployment	- Produce estimates of biomass accumulation on afforestation sites	**High-density canopy maps of afforestation areas, along with estimates of biomass sequestered since project initiation**	Maryland and Pennsylvania	Variable based on Lidar acquisition dates (2004-2015)	30 m	Once	- MRV - Land management - Forest inventory	**Afforestation projects**
Jacob-02 [2014] High-Resolution Constraints on North American and Global Methane Sources Using Satellites	- Provide methane emissions estimates at high resolution on regional scale.	**Anthropogenic and natural methane emissions estimates.**	North America	2009-2015	0.25° x 0.33°	Yearly	- MRV - GHG emissions inventory - Watershed protection plans - Fire management - Air quality protection - Land management	Air quality agencies at both state and national levels (e.g. **EPA, Iowa Department of Natural Resources**), industry groups (e.g. **American Petroleum Institute**), US State Department
Jacob-02 [2014] High-Resolution Constraints on North American and Global Methane Sources Using Satellites	- Provide methane emissions estimates at high resolution on global scale.	**Anthropogenic and natural methane emissions estimates.**	Global	2009-2015	4° x 5°	Yearly	- MRV - GHG emissions inventory - Watershed protection plans - Fire management - Air quality protection - Land management	Air quality agencies at both state and national levels (e.g. **EPA, Iowa Department of Natural Resources**), industry groups (e.g. **American Petroleum Institute**), US State Department
Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Characterize and quantify land-ocean carbon fluxes.	**Estimates of land-ocean fluxes of organic and inorganic carbon, nitrogen, and water**	Southeastern U.S. and South Atlantic Bight	1904-present, present-2099 (projected)	5 arc-minute (or 0.08°)	Monthly	- MRV - Land management - Watershed protection plans - Ocean acidification mitigation and carbon management	**USDA**, EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, **US Global Change Research Program**, **CMS terrestrial flux teams**
Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Characterize and quantify ocean-atmosphere carbon fluxes.	**Estimates/maps of ocean-atmosphere fluxes of carbon dioxide**	Southeastern U.S. and South Atlantic Bight	1904-present, present-2099 (projected)	5 km	Monthly	- Ocean acidification mitigation and carbon management	NOAA, **US Global Change Research Program**
Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Characterize and quantify land-atmosphere carbon fluxes.	**Estimates/maps of land-atmosphere fluxes of carbon dioxide and methane.**	Southeastern U.S. and South Atlantic Bight	1904-present, present-2099 (projected)	5 arc-minute (or 0.08°)	Monthly	- MRV - Land management - Watershed protection plans - Ocean acidification mitigation and carbon management	**USDA**, EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, **US Global Change Research Program**, **CMS terrestrial flux teams**

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Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Characterize and quantify terrestrial carbon storage in biomass.	**Estimates/maps of terrestrial carbon stocks.**	Southeastern U.S. and South Atlantic Bight	1904-present, present-2099 (projected)	5 arc-minute (or 0.08°)	Monthly	- MRV - Land management - Watershed protection plans - Carbon management	**USDA**, EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, **US Global Change Research Program**, **CMS terrestrial flux teams**
Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Quantify uncertainties.	**Associated uncertainties.**	Southeastern U.S. and South Atlantic Bight	1904-present, present-2099 (projected)	5 arc-minute (or 0.08°)	Monthly	- MRV - Land management - Watershed protection plans - Ocean acidification mitigation and carbon management	**USDA**, EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, **US Global Change Research Program**, **CMS terrestrial flux teams**
Lohrenz-05 [2014] An Integrated Terrestrial-Coastal Ocean Observation and Modeling Framework for Carbon Management Decision Support	- Facilitate access to developed georeferenced carbon data products to support operational needs of stakeholders.	**Geospatial portals for sharing developed carbon data products.**	N/A	N/A	N/A	N/A	- MRV - Land management - Watershed protection plans - Ocean acidification mitigation and carbon management	**USDA**, EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, **US Global Change Research Program**, **CMS terrestrial flux teams**
Morton-01 [2014] Long-Term Carbon Consequences of Amazon Forest Degradation	- Quantify the long-term changes in forest carbon stock as a function of degradation history, frequency, and intensity.	**Airborne Lidar data for intact, degraded, and secondary forest types**	3 frontier forests in the Brazilian and Peruvian Amazon: Santarém, Pará, Brazil (old frontier forest); Feliz Natal, Mato Grosso, Brazil (established); and Colonel Portillo, Ucayali, Peru (young).	2014-2015	1m horizontal products (CHM, DTM)	N/A	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	INPE, Embrapa, USAID, US State Department, global carbon cycle community
Morton-01 [2014] Long-Term Carbon Consequences of Amazon Forest Degradation	- Generate estimates of annual forest carbon emissions for each frontier landscape, including deforestation, degradation, and secondary forest dynamics.	**Analysis of secondary forest dynamics.**	3 frontier forests in the Brazilian and Peruvian Amazon: Santarém, Pará, Brazil (old frontier forest); Feliz Natal, Mato Grosso, Brazil (established); and Colonel Portillo, Ucayali, Peru (young).	1985-2014	N/A	Annually	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	INPE, Embrapa, USAID, US State Department, global carbon cycle community
Morton-01 [2014] Long-Term Carbon Consequences of Amazon Forest Degradation	- Generate lidar-based models of aboveground forest biomass for intact and degraded forest types.	**Lidar-biomass models for intact, degraded, and secondary forests.**	3 frontier forests in the Brazilian and Peruvian Amazon: Santarém, Pará, Brazil (old frontier forest); Feliz Natal, Mato Grosso, Brazil (established); and Colonel Portillo, Ucayali, Peru (young).	2014-2016	N/A	N/A	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	INPE, Embrapa, USAID, US State Department, global carbon cycle community

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Morton-01 [2014] Long-Term Carbon Consequences of Amazon Forest Degradation	- Generate estimates of annual forest carbon emissions for each frontier landscape, including deforestation, degradation, and secondary forest dynamics.	**Estimates of annual forest carbon emissions for each frontier landscape**	3 frontier forests in the Brazilian and Peruvian Amazon: Santarém, Pará, Brazil (old frontier forest); Feliz Natal, Mato Grosso, Brazil (established); and Colonel Portillo, Ucayali, Peru (young).	1985-2014	N/A	Annually	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	INPE, Embrapa, USAID, US State Department, global carbon cycle community
Morton-01 [2014] Long-Term Carbon Consequences of Amazon Forest Degradation	- Estimate annual rates of deforestation (intact, degraded, secondary forests) and forest degradation (logging and fire).	**Maps of annual deforestation, forest degradation, and secondary forest dynamics.**	3 frontier forests in the Brazilian and Peruvian Amazon: Santarém, Pará, Brazil (old frontier forest); Feliz Natal, Mato Grosso, Brazil (established); and Colonel Portillo, Ucayali, Peru (young).	1985-2014	30 m	Annually	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	INPE, Embrapa, USAID, US State Department, global carbon cycle community
Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Provide ocean-atmosphere flux estimates. - Quantify uncertainties.	**Maps of observationally constrained ocean-atmosphere fluxes and associated uncertainties.**	Global	2003-2016	0.5° x 0.5°	Monthly	- Global carbon budget calculations - Ocean changes	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Provide land-atmosphere biospheric flux estimates. - Quantify uncertainties.	**Maps of observationally constrained atmosphere-land biosphere fluxes and associated uncertainties.**	Global	2003-2016	0.5° x 0.5°	Monthly	- Global carbon budget calculations - Fire management - Land management - Air quality protection	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Quantify uncertainties of fossil fuel emissions estimates	**Estimates of uncertainty in fossil fuel emissions**	Global	2003-2016	0.5° x 0.5°	Yearly	- GHG emissions inventory - Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Provide simulated atmospheric CO and CO2 concentrations and associated uncertainties	**Estimates of atmospheric CO and CO2 including uncertainty due to flux and transport errors**	Global	2003-2016	0.5° x 0.5°	Daily	- GHG emissions inventory - Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Provide CO and CO2 reanalysis	**High-resolution global atmospheric CO and CO2 concentration reanalyses**	Global	2009-2016	0.5° x 0.5°	Daily	- GHG emissions inventory - Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.

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Ott-01 [2014] GEOS-Carb II: Delivering Carbon Flux and Concentration Products Based on the GEOS Modeling System	- Global inversion flux estimates	**Estimates of terrestrial, oceanic carbon flux based on inverse model calculations and GOSAT/OCO-2 observations**	Global	2009-2013	100+ regions, 3° x 3.75° lat/lon	Monthly	- GHG emissions inventory - Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Walker-W-01 [2014] Direct Measurement of Aboveground Carbon Dynamics in Support of Large-Area CMS Development	- Quantify the certainty with which extensive field, off-the-shelf airborne Lidar, and MODIS satellite data can be used synergistically to estimate wall-to-wall changes in aboveground carbon density.	**Maps of wall-to-wall changes in aboveground carbon density.**	Mexico	2001-2015	500 m	Annual	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	USAID, Chiapas and Campeche jurisdictional governments
Walker-W-01 [2014] Direct Measurement of Aboveground Carbon Dynamics in Support of Large-Area CMS Development	- Quantify the certainty with which extensive field, off-the-shelf airborne Lidar, and VIIRS satellite data can be used synergistically to estimate wall-to-wall changes in aboveground carbon density.	**Maps of wall-to-wall changes in aboveground carbon density.**	Mexico	2012-2016	375 m	Annual	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	USAID, Chiapas and Campeche jurisdictional governments
Walker-W-01 [2014] Direct Measurement of Aboveground Carbon Dynamics in Support of Large-Area CMS Development	- Quantify the certainty with which extensive field, off-the-shelf airborne Lidar, and Landsat 5-8 satellite data can be used synergistically to estimate wall-to-wall changes in aboveground carbon density.	**Maps of wall-to-wall changes in aboveground carbon density.**	Mexican states of Chihuahua, Oaxaca, Campeche, Yucatan, and Quintana Roo	2001-2015	30 - 250 m	Annual	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	USAID, Chiapas and Campeche jurisdictional governments
Walker-W-01 [2014] Direct Measurement of Aboveground Carbon Dynamics in Support of Large-Area CMS Development	- Conduct an independent accuracy assessment of the aboveground carbon density change products produced as well as of derivative estimates of gross emissions.	**Accuracy assessment of the aboveground carbon density change products and derivative estimates of gross emissions.**	Mexico	N/A	N/A	N/A	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	USAID, Chiapas and Campeche jurisdictional governments
Williams-C-01 [2014] Translating Forest Change to Carbon Emissions/Removals Linking Disturbance Products, Biomass Maps, and Carbon Cycle Modeling in a Comprehensive Carbon Monitoring Framework	- Build a new capacity for a more thorough carbon stock and flux monitoring framework to deliver a new tool for REDD+ Tier 3 MRV, decision support, and forecasting, all with process-specificity. - Provide forest carbon flux estimates. - Further characterize the attributes of forested pixels beyond the regionally-defined strata. - Prepare the framework for more complete assessment of the forest sector carbon balance.	**Maps of forest carbon fluxes, with pixel-level information on pre-disturbance biomass, disturbance type, and disturbance severity -- in addition to the incorporation of the fate of harvested wood products.**	CONUS	1990-2011	1 km x 1 km	Annually	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Forest inventory - Land management	EPA, USFS, forest resource managers and planners for assessing carbon sink and source dynamics.
Williams-C-01 [2014] Translating Forest Change to Carbon Emissions/Removals Linking Disturbance Products, Biomass Maps, and Carbon Cycle Modeling in a Comprehensive Carbon Monitoring Framework	- Build a new capacity for a more thorough carbon stock and flux monitoring framework to deliver a new tool for REDD+ Tier 3 MRV, decision support, and forecasting, all with process-specificity. - Provide aboveground biomass estimates.	**Maps of forest carbon stocks, with pixel-level information on forest type, site productivity, and age.**	CONUS	1990-2011	1 km x 1 km	Annually	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Forest inventory - Land management	EPA, USFS, forest resource managers and planners for assessing carbon sink and source dynamics.

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Williams-C-01 [2014] Translating Forest Change to Carbon Emissions/Removals Linking Disturbance Products, Biomass Maps, and Carbon Cycle Modeling in a Comprehensive Carbon Monitoring Framework	- Test carbon implications of likely management and natural disturbance scenarios.	**Estimates of forecasted forest carbon stocks and fluxes under likely management and natural disturbance scenarios.**	CONUS	2012-2050	0.5 deg x 0.5 deg	Annually	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Forest inventory - Land management	EPA, USFS, forest resource managers and planners for assessing carbon sink and source dynamics.
Windham-Myers-01 [2014] Linking Satellite and Soil Data to Validate Coastal Wetland 'Blue Carbon' Inventories: Upscaled Support for Developing MRV and REDD+ Protocols	- Develop a verifiable IPCC-relevant, temporally-explicit coastal wetland carbon monitoring protocol appropriate for national policy and market interventions.	**Accounting methodology for coastal wetland carbon stocks and fluxes.**	CONUS	1992-2011	30 m	Once	- MRV, REDD+ - GHG emissions inventory - Watershed protection plans - Land management	**EPA** *Tom Wirth*, **NOAA**, **USFWS**, **Louisiana Coastal Wetlands Conservation and Restoration Task Force,** USDA, Council for Environmental Cooperation, voluntary and regulatory carbon markets
Windham-Myers-01 [2014] Linking Satellite and Soil Data to Validate Coastal Wetland 'Blue Carbon' Inventories: Upscaled Support for Developing MRV and REDD+ Protocols	- Quantify coastal wetland carbon stocks.	**Maps of coastal wetland carbon stocks**	6 sentinel sites along representative coasts of the U.S. (Pudget Sound, San Francisco Bay, Barataria coast of Louisiana, Everglades, Chesapeake Bay, Cape Cod)	1992-2011	30 m	Once	- MRV, REDD+ - GHG emissions inventory - Watershed protection plans - Land management	**EPA** *Tom Wirth*, **NOAA**, **USFWS**, **Louisiana Coastal Wetlands Conservation and Restoration Task Force,** USDA, Council for Environmental Cooperation, voluntary and regulatory carbon markets
Windham-Myers-01 [2014] Linking Satellite and Soil Data to Validate Coastal Wetland 'Blue Carbon' Inventories: Upscaled Support for Developing MRV and REDD+ Protocols	- Quantify coastal wetland carbon fluxes.	**Estimates of coastal wetland carbon fluxes.**	6 sentinel sites along representative coasts of the U.S. (Pudget Sound, San Francisco Bay, Barataria coast of Louisiana, Everglades, Chesapeake Bay, Cape Cod)	1992-2011	30 m	Once	- MRV, REDD+ - GHG emissions inventory - Watershed protection plans - Land management	**EPA** *Tom Wirth*, **NOAA**, **USFWS**, **Louisiana Coastal Wetlands Conservation and Restoration Task Force,** USDA, Council for Environmental Cooperation, voluntary and regulatory carbon markets
Windham-Myers-01 [2014] Linking Satellite and Soil Data to Validate Coastal Wetland 'Blue Carbon' Inventories: Upscaled Support for Developing MRV and REDD+ Protocols	- Quantify uncertainties. - Determine price of precision or extent to which finer habitat classifications (hydrology, salinity, sea-level rise) continue to inform carbon accounting with greater accuracy.	**MRV error analyses across a series of data-driven scales.**	6 sentinel sites along representative coasts of the U.S. (Pudget Sound, San Francisco Bay, Barataria coast of Louisiana, Everglades, Chesapeake Bay, Cape Cod)	1992-2011	30 m	Once	- MRV, REDD+ - GHG emissions inventory - Watershed protection plans - Land management	**EPA** *Tom Wirth*, **NOAA**, **USFWS**, **Louisiana Coastal Wetlands Conservation and Restoration Task Force,** USDA, Council for Environmental Cooperation, voluntary and regulatory carbon markets
Asrar-West-04 [2013] Carbon Monitoring of Agricultural Lands: Developing a Globally Consistent Estimate of Carbon Stocks and Fluxes	- Provide global bottom-up, inventory-based estimates of cropland carbon stocks and fluxes.	**Cropland NPP; Soil C stock; soil C change**	Global	2005-2011 (also 1960-2011 at the global province scale)	0.05°	Annually	- GHG emissions inventory - Land management	**USDA**, **EPA**, FAO, US State Department

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Asrar-West-04 [2013] Carbon Monitoring of Agricultural Lands: Developing a Globally Consistent Estimate of Carbon Stocks and Fluxes	- Provide global bottom-up, inventory-based estimates of cropland carbon stocks and fluxes.	**Cropland CO2 flux; Soil C stock change; Livestock CO2 and CH4 Flux; Human CO2 (respiration); and Net cropland biogenic carbon flux**	Global	2005-2011 (also 1960-2011 at the global province scale)	0.05°	Annually	- GHG emissions inventory - Land management	**USDA**, **EPA**, FAO, US State Department
Cochrane-01 [2013] Filling a Critical Gap in Indonesia's National Carbon Monitoring, Reporting, and Verification Capabilities for Supporting REDD+ Activities	- Create an MRV system that quantifies fire emissions on local-scale in tropical peat-swamp forests for inventory and land management purposes.	**Estimates of peat fire-related emissions.**	Central Kalimantan, Indonesia	2007-2011 and 2014	30 m	Annually	- MRV, REDD+ - Fire management - GHG emissions inventory - Forest inventory - Land management - Air quality protection	**Indonesian government's Forestry Research and Development Agency**, LAPAN, IPCC TFI, Australian Agency for International Aid, **USAID, USFS**
Cochrane-01 [2013] Filling a Critical Gap in Indonesia's National Carbon Monitoring, Reporting, and Verification Capabilities for Supporting REDD+ Activities	- Create an MRV system that quantifies fire emissions on local-scale in tropical peat-swamp forests for inventory and land management purposes.	**Estimates of land cover changes.**	Central Kalimantan, Indonesia	1997-2016	30 m	Annually	- MRV, REDD+ - Fire management - GHG emissions inventory - Forest inventory - Land management - Air quality protection	**Indonesian government's Forestry Research and Development Agency**, LAPAN, IPCC TFI, Australian Agency for International Aid, **USAID, USFS**
Cochrane-01 [2013] Filling a Critical Gap in Indonesia's National Carbon Monitoring, Reporting, and Verification Capabilities for Supporting REDD+ Activities	- Create an MRV system that quantifies fire emissions on local-scale in tropical peat-swamp forests for inventory and land management purposes.	**Estimates of burned area.**	Central Kalimantan, Indonesia	1997-2016	30 m	Annually	- MRV, REDD+ - Fire management - GHG emissions inventory - Forest inventory - Land management - Air quality protection	**Indonesian government's Forestry Research and Development Agency**, LAPAN, IPCC TFI, Australian Agency for International Aid, **USAID, USFS**
Cochrane-01 [2013] Filling a Critical Gap in Indonesia's National Carbon Monitoring, Reporting, and Verification Capabilities for Supporting REDD+ Activities	- Create an MRV system that quantifies fire emissions on local-scale in tropical peat-swamp forests for inventory and land management purposes.	**Estimates of timing of fire activity.**	Central Kalimantan, Indonesia	2000-2016	30 m	Annually	- MRV, REDD+ - Fire management - GHG emissions inventory - Forest inventory - Land management - Air quality protection	**Indonesian government's Forestry Research and Development Agency**, LAPAN, IPCC TFI, Australian Agency for International Aid, **USAID, USFS**
Cohen-02 [2013] An Historically Consistent and Broadly Applicable MRV System Based on Lidar Sampling and Landsat Time-Series	- Create an MRV system that use field plot, airborne Lidar, and satellite data to quantify carbon stocks for inventory and land management purposes. - Provide historical data.	**Maps and estimates of disturbance.**	CONUS (Maine, Pennsylvania, New Jersey, South Carolina, Minnesota, Colorado, & Oregon)	1972-2014	30 m	Annually	- MRV - Fire management - Forest inventory - Land management - Invasive species - Air quality protection	IPCC TFI, **USFS**, EPA, US State Department, USGS, **White House Council on Environmental Quality** ***Chris Woodall***, SilvaCarbon
Cohen-02 [2013] An Historically Consistent and Broadly Applicable MRV System Based on Lidar Sampling and Landsat Time-Series	- Create an MRV system that use field plot, airborne Lidar, and satellite data to quantify carbon stocks for inventory and land management purposes. - Provide historical data.	**Maps and estimates of aboveground biomass.**	CONUS (Maine, Pennsylvania, New Jersey, South Carolina, Minnesota, Colorado, & Oregon)	1990-2014	30 m	Annually	- MRV - Fire management - Forest inventory - Land management - Invasive species - Air quality protection	IPCC TFI, **USFS**, EPA, US State Department, USGS, **White House Council on Environmental Quality** ***Chris Woodall***, SilvaCarbon

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Collatz-02 [2013] Improving and Extending CMS Land Surface Carbon Flux Products Including Estimates of Uncertainties in Fluxes and Biomass	- Provide global terrestrial carbon fluxes at appropriate spatial and temporal resolutions in order to improve the CMS FPP.	**Estimates of terrestrial carbon fluxes: Gross Primary Productivity (GAP)/ Net Primary Productivity (NPP), Net Biome Production (NAP), Ecosystem Respiration (RE)/ Heterotrophic Respiration (RH), and fire emissions.**	Global	2003-2014	0.5° x 0.5° and 1° x 1.25°	Monthly at 0.5° resolution and 3-hourly at 1° x 1.25° resolution	- Global carbon budget calculations - Fire management - Land management - Air quality protection	**CMS atmospheric modeling groups (i.e. Bowman-01, Pawson-01, Andrews-02, Nehrkorn-01, French-04), other atmospheric scientists (e.g. those involved in the NASA ASCENDS mission)**
Collatz-02 [2013] Improving and Extending CMS Land Surface Carbon Flux Products Including Estimates of Uncertainties in Fluxes and Biomass	- Provide global estimates of biomass live and detritus in order to improve the CMS FPP and biomass estimates.	**Maps of above- and below-ground biomass live and above- and below-ground biomass detritus.**	Global	2003-2014	0.5° x 0.5°	Annually	- Global carbon budget calculations - Fire management - Land management - Air quality protection	Scientists who are interested in modeled biomass estimates (**French-04**)
Collatz-02 [2013] Improving and Extending CMS Land Surface Carbon Flux Products Including Estimates of Uncertainties in Fluxes and Biomass	- Quantify uncertainties of flux and biomass estimates.	**Associated uncertainties for both fluxes and biomass.**	Global	2003-2014	0.5° x 0.5° and 1° x 1.25°	Monthly and annually at 0.5° resolution and 3-hourly at 1° x 1.25° resolution	- Global carbon budget calculations - Fire management - Land management - Air quality protection	**Pawson-01, Bowman-01**
Dubayah-04 [2013] Development of a Prototype MRV System to Support Carbon Ecomarket Infrastructure in Sonoma County	- Create an MRV system that quantifies carbon stocks on local-scale at high resolution in order to support a carbon ecomarket infrastructure.	**Canopy height, ground digital elevation model (DEM), and forest/non-forest maps -- and associated point cloud data.**	Sonoma County, California	2013	1m and 30 m	N/A	- MRV - Land management - Forest inventory	Habitat preservation groups (i.e. **Sonoma County Agriculture & Open Space Preservation District**, The Conservation Fund, The Nature Conservancy), nutrient trading & hydrology groups (i.e. city wastewater treatment facilities, California Department of Environment), commercial agriculture groups (precision agriculture and yield productivity consultants, fertilizer companies providing variable rate application services), wildfire fuels modeling groups (California Department of Forestry and Fire Protection, U.S. Forest Service in California), forest management companies (Mendocino Redwood company), national and global entities that want to validate top down products.

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Dubayah-04 [2013] Development of a Prototype MRV System to Support Carbon Ecomarket Infrastructure in Sonoma County	- Create an MRV system that quantifies carbon stocks on local-scale at high resolution in order to support a carbon ecomarket infrastructure.	**Aboveground biomass and associated uncertainty maps.**	Sonoma County, California	2013	30 m and 1 ha	N/A	- MRV - Land management - Forest inventory	Habitat preservation groups (i.e. **Sonoma County Agriculture & Open Space Preservation District**, The Conservation Fund, The Nature Conservancy), nutrient trading & hydrology groups (i.e. city wastewater treatment facilities, California Department of Environment), commercial agriculture groups (precision agriculture and yield productivity consultants, fertilizer companies providing variable rate application services), wildfire fuels modeling groups (California Department of Forestry and Fire Protection, U.S. Forest Service in California), forest management companies (Mendocino Redwood company), national and global entities that want to validate top down products.
Dubayah-04 [2013] Development of a Prototype MRV System to Support Carbon Ecomarket Infrastructure in Sonoma County	- Create an MRV system that quantifies carbon stocks on local-scale at high resolution in order to support a carbon ecomarket infrastructure.	**ED based maps of carbon stocks and flux.**	Sonoma County, California	2013	90 m	N/A	- MRV - Land management - Forest inventory	Habitat preservation groups (i.e. **Sonoma County Agriculture & Open Space Preservation District**, The Conservation Fund, The Nature Conservancy), nutrient trading & hydrology groups (i.e. city wastewater treatment facilities, California Department of Environment), commercial agriculture groups (precision agriculture and yield productivity consultants, fertilizer companies providing variable rate application services), wildfire fuels modeling groups (California Department of Forestry and Fire Protection, U.S. Forest Service in California), forest management companies (Mendocino Redwood company), national and global entities that want to validate top down products.
Dubayah-04 [2013] Development of a Prototype MRV System to Support Carbon Ecomarket Infrastructure in Sonoma County	- Predict carbon sequestration potential under land use and climate change scenarios using ecosystem modeling (ED).	**ED based maps of carbon sequestration potential.**	Sonoma County, California	2013	90 m	N/A	- MRV - Land management - Forest inventory	Habitat preservation groups (i.e. **Sonoma County Agriculture & Open Space Preservation District**, The Conservation Fund, The Nature Conservancy), nutrient trading & hydrology groups (i.e. city wastewater treatment facilities, California Department of Environment), commercial agriculture groups (precision agriculture and yield productivity consultants, fertilizer companies providing variable rate application services), wildfire fuels modeling groups (California Department of Forestry and Fire Protection, U.S. Forest Service in California), forest management companies (Mendocino Redwood company), national and global entities that want to validate top down products.

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Dubey-01 [2013] Off-the-shelf Commercial Compact Solar FTS for CO2 and CH4 Observations for MRV	- Evaluate the precision, accuracy, and stability of a new off-the-shelf, compact, affordable, easy-to-use, and low-resolution spectrometer in comparison to those currently used to monitor CO2 and CH4.	**Performance evaluation of a new off-the-shelf, low-resolution MRV technology, which includes measurements of regional total column XCO2 and XCH4 observations.**	Global, with focus on developing countries in Asia (China & India), South America, and Africa	2014-2015	10 km	Every 5 minutes during daytime sampling	- MRV, REDD+ - GHG emissions inventory - Global carbon budget calculations - Land management	DOE, EPA, certain CMS projects, Total Carbon Column Observing Network (TCCON), Orbiting Carbon Observatory-2 (OCO-2) science team, U.S. Global Change Research Program
Duren-01 [2013] Understanding User Needs for Carbon Monitoring Information	- Engage the user community and identify needs for policy-relevant carbon monitoring information	**Policy briefs summarizing user needs for carbon data.**	Local to Global	2010-2100	various	various	Policy formulation; inventory diagnosis; project/facility level MRV; state/national level MRV; technical capacity building; direct mitigation support; monitoring capability assessments; projections	CMS science team and NASA program management; other carbon research agencies (NOAA, USDA, DOE, etc)
Duren-01 [2013] Understanding User Needs for Carbon Monitoring Information	- Evaluate current and planned NASA CMS data products with regard to their value for decision making	**White papers reporting results of data product evaluations.**	Local to global	2010-2100	various	various	Policy formulation; inventory diagnosis; project/facility level MRV; state/national level MRV; technical capacity building; direct mitigation support; monitoring capability assessments; projections	CMS science team and NASA program management; other carbon research agencies (NOAA, USDA, DOE, etc)
Duren-01 [2013] Understanding User Needs for Carbon Monitoring Information	- Explore alternative methods for visualizing and communicating carbon monitoring information and associated uncertainties to decision makers and other stakeholders.	**Carbon Calculator/ Data Portal that integrates multiple CMS products to support evaluation and decision support.**	Currently CONUS (ultimately Global)	2002-2012 (coverage varies by data layer)	0.1 to 50 km	monthly	Policy formulation; inventory diagnosis; project/facility level MRV; state/national level MRV; technical capacity building; direct mitigation support; monitoring capability assessments; projections	U.S. State Department, US EPA, White House Council on Environmental Quality, US Forest Service, California Air Resources Board, etc
Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Broaden and strengthen the knowledge of CMS data products by engaging the research and applications communities that will benefit from the CMS initiative - Explore ways to evaluate the impact of CMS data products on decision making, economic benefits, and improved understanding of carbon cycle science	**Evaluation of stakeholders' end uses of CMS products**	Local (County and state scale)	2013 - 2016	N/A	N/A	- MRV - GHG emissions inventory - Land management - Forest inventory - Fire management - Invasive species - Watershed protection plans - Ocean acidification mitigation - Fisheries regulations - Coastal land management - Air quality protection - Cap-and-trade program - Urbanization policies - Global carbon budget calculations -Impervious surface	Any stakeholder who is interested in transitioning carbon science derived products to decision-making frameworks. (i.e. NASA, CCIWG, DOE, EPA, USDA, USFS, NOAA, USAID, State Department, California Air Resources Board, Sonoma County Agricultural Preservation and Open Space District, Conservation International, Ocean Conservancy, Maryland DNR, Delaware DNR, Pennsylvania DNR)

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Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Broaden and strengthen the knowledge of CMS data products by engaging the research and applications communities that will benefit from the CMS initiative - Inform the CMS product developers of the information scale and decision domain of stakeholders, policy makers, and end-users.	**Applications workshops and reports**	Variable	2013 - 2016	N/A	N/A	- MRV - GHG emissions inventory - Land management - Forest inventory - Fire management - Invasive species - Watershed protection plans - Ocean acidification mitigation - Fisheries regulations - Coastal land management - Air quality protection - Cap-and-trade program - Urbanization policies - Global carbon budget calculations -Impervious surface	Any stakeholder who is interested in transitioning carbon science products to decision-making frameworks. (i.e. NASA, CCIWG, DOE, EPA, USDA, USFS, NOAA, USAID, State Department, California Air Resources Board, Sonoma County Agricultural Preservation and Open Space District, Conservation International, Ocean Conservancy, Maryland DNR, Delaware DNR, Pennsylvania DNR)
Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Provide tools and activities that translate the CMS science in a way that will allow stakeholders and decision makers understand the capabilities of the CMS science products	**CMS Products Fact Sheet and Application Readiness Level (ARL) figures for all 2012, 2013, and 2014 projects**	N/A	2012 - 2016	N/A	N/A	- MRV - GHG emissions inventory - Land management - Forest inventory - Fire management - Invasive species - Watershed protection plans - Ocean acidification mitigation - Fisheries regulations - Coastal land management - Air quality protection - Cap-and-trade program - Urbanization policies - Global carbon budget calculations	In addition to CMS science team, any stakeholder who is interested in transitioning carbon science products to decision-making frameworks. (i.e. NASA, CCIWG, DOE, EPA, USDA, USFS, NOAA, USGS, USAID, State Department, California Air Resources Board, Sonoma County Agricultural Preservation and Open Space District, Conservation International, Ocean Conservancy, Maryland DNR, Delaware DNR, Pennsylvania DNR)
Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Inform the CMS product developers of the information scale and decision domain of stakeholders, policy makers, and end-users	**CMS Applications Policy Speaker Series**	N/A	2014 - 2016	N/A	N/A	- MRV - GHG emissions inventory - Land management - Forest inventory - Fire management - Invasive species - Watershed protection plans - Ocean acidification mitigation - Fisheries regulations - Coastal land management - Air quality protection - Cap-and-trade program - Urbanization policies - Global carbon budget calculations	Any carbon scientist or stakeholder who is interested in transitioning carbon science products to decision-making frameworks.

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Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Provide tools and activities that translate the CMS science in a way that will allow stakeholders and decision makers understand the capabilities of the CMS science products	**Translation of science language for the CMS website**	N/A	2014 - 2016	N/A	N/A	- MRV - GHG emissions inventory - Land management - Forest inventory - Fire management - Invasive species - Watershed protection plans - Ocean acidification mitigation - Fisheries regulations - Coastal land management - Air quality protection - Cap-and-trade program - Urbanization policies - Global carbon budget calculations	Any carbon scientist or stakeholder who is interested in transitioning carbon science products to decision-making frameworks.
Escobar-01 [2013] Applications of the NASA Carbon Monitoring System: Engagement, Use, and Evaluation	- Explore ways to evaluate the impact of CMS data products on decision making, economic benefits, and improved understanding of carbon cycle science	**Economic (cost-benefit) analysis of LiDAR data use in the Maryland forestry program**	Maryland	2013 - 2015	N/A	N/A	- Forest inventory - Land management - Invasive species - Watershed protection plans	Maryland Department of Natural Resources, Baltimore Washington Partners for Forest Stewardship, USFS
Graven-01 [2013] Quantifying Fossil and Biospheric CO2 Fluxes in California Using Ground-Based and Satellite Observations	- Observe spatial patterns of fossil fuel-derived and biospheric CO2 in California by field sampling and measurement of radiocarbon in CO2 from a network of tower sites, use radiocarbon observations with in situ and satellite CO2 measurements in regional CO2 inversion, quantify uncertainties, and compare with bottom-up inventories.	**Fossil fuel emissions estimates.**	California	May 2014, Oct-Nov 2014, Jan-Feb 2015	Statewide, sub-state regions of greater than 100 km2	Several one-month periods in 2014-15	- MRV - GHG emissions inventory - Cap-and-trade program - Land management	California Air Resources Board, California Resources Agency, California Energy Commission
Graven-01 [2013] Quantifying Fossil and Biospheric CO2 Fluxes in California Using Ground-Based and Satellite Observations	- Observe spatial patterns of fossil fuel-derived and biospheric CO2 in California by field sampling and measurement of radiocarbon in CO2 from a network of tower sites, use radiocarbon observations with in situ and satellite CO2 measurements in regional CO2 inversion, quantify uncertainties, and compare with bottom-up inventories.	**Biospheric CO2 flux estimates.**	California	May 2014, Oct-Nov 2014, Jan-Feb 2015	Statewide, sub-state regions of greater than 100 km2	Several one-month periods in 2014-16	- MRV - GHG emissions inventory - Cap-and-trade program - Land management	California Air Resources Board, California Resources Agency, California Energy Commission
Hagen-01 [2013] Operational Multi-Sensor Design for National Scale Forest Carbon Monitoring to Support REDD+ MRV Systems	- Produce improved wall-to-wall forest carbon stock maps using Lidar, radar, and optical data in support of developing a National Forest Monitoring System in Kalimantan, Indonesia.	**Map of forest carbon stocks.**	5 provinces of Kalimantan, Indonesia	2010	100 m	Only one sampling snapshot for 2010	- MRV, REDD+ - Forest inventory - Land management	**Indonesian Ministry of Forestry *Dirk Hoekman***, **Indonesia REDD+ Office of President *Heru Prasetyo***, Indonesian government's Forestry Research and Development Agency, **LAPAN**, IPCC TFI, **US State Department, USFS, USAID**
Hagen-01 [2013] Operational Multi-Sensor Design for National Scale Forest Carbon Monitoring to Support REDD+ MRV Systems	- Map carbon emissions associated with forest degradation using Lidar and radar in support of developing a National Forest Monitoring System in Kalimantan, Indonesia.	**Maps of forest carbon fluxes.**	5 provinces of Kalimantan, Indonesia	2010-2015	100 m	Annually	- MRV, REDD+ - Forest inventory - Land management	**Indonesian Ministry of Forestry *Dirk Hoekman***, **Indonesia REDD+ Office of President *Heru Prasetyo***, Indonesian government's Forestry Research and Development Agency, **LAPAN**, IPCC TFI, **US State Department, USFS, USAID**

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Hagen-01 [2013] Operational Multi-Sensor Design for National Scale Forest Carbon Monitoring to Support REDD+ MRV Systems	- Develop an uncertainty tracking system for carbon monitoring.	**An uncertainty tracking system.**	5 provinces of Kalimantan, Indonesia	NA	100 m	Annually	- MRV, REDD+ - Forest inventory - Land management	**Indonesian Ministry of Forestry *Dirk Hoekman*, Indonesia REDD+ Office of President *Heru Prasetyo***, Indonesian government's Forestry Research and Development Agency, **LAPAN**, IPCC TFI, **US State Department, USFS, USAID**
Keller-01 [2013] A Data Assimilation Approach to Quantify Uncertainty for Estimates of Biomass Stocks and Changes in Amazon Forests	- Quantify spatially explicit aboveground carbon stocks, changes in carbon stocks, and uncertainties.	**Maps of aboveground carbon stocks.**	Paragominas, Brazil	2012-2015	100 m	2 sampling snapshots, one in 2012 and another in 2014	- MRV, REDD+ - Forest inventory - Land management	Municipality of Paragominas, State of Para, Brazilian Ministry of the Environment, Brazilian Space Agency, Instituto Floresta Tropical, Imazon
Keller-01 [2013] A Data Assimilation Approach to Quantify Uncertainty for Estimates of Biomass Stocks and Changes in Amazon Forests	- Quantify spatially explicit aboveground carbon stocks, changes in carbon stocks, and uncertainties.	**Maps of changes in carbon stocks.**	Paragominas, Brazil	2012-2015	100 m	2 sampling snapshots, one in 2012 and another in 2014	- MRV, REDD+ - Forest inventory - Land management	Municipality of Paragominas, State of Para, Brazilian Ministry of the Environment, Brazilian Space Agency, Instituto Floresta Tropical, Imazon
Keller-01 [2013] A Data Assimilation Approach to Quantify Uncertainty for Estimates of Biomass Stocks and Changes in Amazon Forests	- Quantify spatially explicit aboveground carbon stocks, changes in carbon stocks, and uncertainties.	**Maps of spatially explicit associated uncertainties in biomass.**	Paragominas, Brazil	2012-2015	100 m	2 sampling snapshots, one in 2012 and another in 2014	- MRV, REDD+ - Forest inventory - Land management	Municipality of Paragominas, State of Para, Brazilian Ministry of the Environment, Brazilian Space Agency, Instituto Floresta Tropical, Imazon
Keller-01 [2013] A Data Assimilation Approach to Quantify Uncertainty for Estimates of Biomass Stocks and Changes in Amazon Forests	- Quantify spatially explicit aboveground carbon stocks, changes in carbon stocks, and uncertainties.	**Maps of spatially explicit associated uncertainties in stock change.**	Paragominas, Brazil	2012-2015	100 m	2 sampling snapshots, one in 2012 and another in 2014	- MRV, REDD+ - Forest inventory - Land management	Municipality of Paragominas, State of Para, Brazilian Ministry of the Environment, Brazilian Space Agency, Instituto Floresta Tropical, Imazon
KellIndorfer-03 [2013] Time Series Fusion of Optical and Radar Imagery for Improved Monitoring of Activity Data, and Uncertainty Analysis of Emission Factors for Estimation of Forest Carbon Flux	- Quantify forest carbon fluxes and uncertainties in support of developing national MRV systems for REDD+.	**Estimates of carbon flux from deforestation, forest degradation, and forest regrowth.**	Peru, Colombia, and Mexico	1996-2014	1 ha	Annually	- MRV, REDD+ - Forest inventory - GHG emissions inventory - Land management	**Peruvian Ministry of Environment**; **Colombian Ministry of Environment**; **Colombian Institute of Hydrology, Meteorology, and Environmental Studies**; **Mexican National Commission for Knowledge and Use of Biodiversity**; **Mexican National Forestry Commission**; USAID
Lauvaux-01 [2013] Quantification of the Sensitivity of NASA CMS Flux Inversions to Uncertainty in Atmospheric Transport	- Improve the CMS FPP by investigating the role of atmospheric transport.	**Estimates of the sensitivity of NASA CMS Flux inversions to uncertainty in atmospheric transport.**	North America	2010	4° x 5°	Monthly	- Global carbon budget calculations - Global carbon flux, atmospheric validation, monitoring systems for carbon fluxes	**Certain CMS projects**, EPA, **NOAA** Carbon Tracking group
Morton-02 [2013] A Joint USFS-NASA Pilot Project to Estimate Forest Carbon Stocks in Interior Alaska by Integrating Field, Airborne and Satellite Data	- Quantify forest carbon stocks and uncertainties in a region with sparse ground-based data for inventory and management purposes.	**Maps of carbon stocks with pixel-level carbon estimates and pixel-level uncertainties.**	Tanana Forest Management District of Interior Alaska (Tetlin Wildlife Refuge, Bonanzo Creek Experimental Forest, Caribou Poker Creeks Experimental Watersheds,	July and August of 2014	30 m	1 sampling snapshot	- MRV - Forest inventory - Land management	**USFS in Alaska**, NASA CMS and ABoVE science teams

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			Tanana Valley State Forest, and USFS Tanana Inventory Unit)					
Morton-02 [2013] A Joint USFS-NASA Pilot Project to Estimate Forest Carbon Stocks in Interior Alaska by Integrating Field, Airborne and Satellite Data	- Provide statistical estimates of forest carbon stocks with uncertainties for comparison purposes.	**Statistical estimates of carbon stocks at stratum level.**	Tanana Forest Management District of Interior Alaska (Tetlin Wildlife Refuge, Bonanzo Creek Experimental Forest, Caribou Poker Creeks Experimental Watersheds, Tanana Valley State Forest, and USFS Tanana Inventory Unit)	July and August of 2014	stratum-level	1 sampling snapshot	- MRV - Forest inventory - Land management	**USFS in Alaska**, NASA CMS and ABoVE science teams
Nehrkorn-01 [2013] Prototype Monitoring, Reporting and Verification System for the Regional Scale: The Boston-DC Corridor	- Develop a measurement network and an atmospheric modeling framework for downscaling the current CMS flux products to regional and local scales pertinent to MRV.	**Measurements of CO2 concentrations.**	Boston-DC urban corridor	mid-2013 to present	N/A (point measurements)	Hourly	- MRV - Urbanization policies - Cap-and-trade program - GHG emissions inventory - Land management	USFS, Baltimore Washington Forest Stewardship Partnership, Maryland Department of Natural Resources, EPA (Regions 1, 2, & 3)
Nehrkorn-01 [2013] Prototype Monitoring, Reporting and Verification System for the Regional Scale: The Boston-DC Corridor	- Develop a measurement network and an atmospheric modeling framework for downscaling the current CMS flux products to regional and local scales pertinent to MRV.	**CO2 flux estimates.**	Boston-DC urban corridor	mid-2013 to present	1 km	hourly	- MRV - Urbanization policies - Cap-and-trade program - GHG emissions inventory - Land management	USFS, Baltimore Washington Forest Stewardship Partnership, Maryland Department of Natural Resources, EPA (Regions 1, 2, & 3)
Nehrkorn-01 [2013] Prototype Monitoring, Reporting and Verification System for the Regional Scale: The Boston-DC Corridor	- Develop a measurement network and an atmospheric modeling framework for downscaling the current CMS flux products to regional and local scales pertinent to MRV.	**Meteorological (atmospheric transport) modeling outputs.**	Boston-DC urban corridor	mid-2013 to present	Nested grids with grid spacing between 1-30 km, finer than 10 km over area of interest	Every 10 minutes to hourly, depending on horizontal resolution of the nested grids	- MRV - Urbanization policies - Cap-and-trade program - GHG emissions inventory - Land management	USFS, Baltimore Washington Forest Stewardship Partnership, Maryland Department of Natural Resources, EPA (Regions 1, 2, & 3)
Stehman-01 [2013] Developing Statistically Rigorous Sampling Design and Analysis Methods to Reduce and Quantify Uncertainties Associated with Carbon Monitoring Systems	- Develop sampling methodology of key parameters of a carbon monitoring system that minimizes uncertainty and financial costs using field plot, airborne, and satellite data.	**Sampling design and analysis methods to quantify and reduce uncertainties associated with carbon monitoring systems.**	Global	N/A	N/A	N/A	- MRV, REDD+	**Certain CMS projects** and any REDD+ project that seeks to use remote sensing data to quantify impacts from land cover changes.
Vargas-01 [2013] A Framework for Carbon Monitoring and Upscaling in Forests across Mexico to Support Implementation of REDD+	- Create an MRV system that quantifies forest carbon stocks, dynamics, and uncertainties from ecosystem- to regional-scales for inventory and land management purposes.	**Methodologies for upscaling carbon stocks and dynamics from forest inventories to regional scale.**	Mexico	2000-2015	5 km	Monthly	- MRV, REDD+ - Forest inventory - Land management	USFS, **Mexican National Forestry Commission**, Canadian Forest Service
Andrews-02 [2012] North American Regional-Scale Flux Estimation and Observing System Design for the NASA Carbon Monitoring System	- Use in situ observations and remote sensing data (ACOS GOSAT + TCCON) together in a regional inverse modeling framework for North America. - Compare with CMS Flux Pilot Project (FPP) results.	**CO2 flux estimates.**	North America	July 2009 – December 2010	1° x 1°	3-hourly	- GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project

Project ID / Award Year / Title	Objectives	Products	Spatial Extent	Time Period	Spatial Resolution	Temporal Frequency	Application Areas	Potential Users
Andrews-02 [2012] North American Regional-Scale Flux Estimation and Observing System Design for the NASA Carbon Monitoring System	- Use in situ observations and remote sensing data (ACOS GOSAT + TCCON) together in a regional inverse modeling framework for North America. - Compare with CMS Flux Pilot Project (FPP) results.	**Estimated CO2 profiles corresponding to GOSAT XCO2 observations.**	North America	July 2009 – December 2010	N/A	N/A	- GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project
Andrews-02 [2012] North American Regional-Scale Flux Estimation and Observing System Design for the NASA Carbon Monitoring System	- Quantify fluxes at scales relevant for MRV using strategies that incorporate diverse carbon dioxide observations.	**Measurement sampling footprints**	North America	2007-2010; 1 July - 20 August 2012	1° latitude x 1° longitude; 0.1° latitude x 0.1° longitude for subdomain centered on measurement location	Hourly	- MRV, REDD+ - GHG emissions inventory - Cap-and-trade program - Land management	EPA, USDA, NASA (GOSAT, ACOS, & **OCO-2** *__Chris O'Dell__* science teams), and stakeholders of any emissions verification project, other atmospheric transport modelers and inverse modelers
Balch-03 [2010, continued beyond 2012] Coccolithophores of the Beaufort and Chukchi Seas: Harbingers of a Polar Biogeochemical Province in Transition	- Collect various biological and bio-optical observations to address the role of calcifiers in the Arctic Ocean.	**Measurements of calcification rate (including total primary productivity).**	Western Arctic Ocean	June and July of 2011	Not Applicable, involves direct biological samplings along km-scale transects	Daily	- Fisheries regulations - Ocean acidification mitigation - Global carbon budget calculations - Coastal land management	NOAA, EPA, Global Carbon Project (GCP), NASA
Balch-03 [2010, continued beyond 2012] Coccolithophores of the Beaufort and Chukchi Seas: Harbingers of a Polar Biogeochemical Province in Transition	- Collect various biological and bio-optical observations to address the role of calcifiers in the Arctic Ocean.	**Measurements of particulate inorganic carbon and biogenic silica concentrations.**	Western Arctic Ocean	June and July of 2011	Not Applicable, involves direct biological samplings along km-scale transects	Daily	- Fisheries regulations - Ocean acidification mitigation - Global carbon budget calculations - Coastal land management	NOAA, EPA, Global Carbon Project (GCP), NASA
Balch-03 [2010, continued beyond 2012] Coccolithophores of the Beaufort and Chukchi Seas: Harbingers of a Polar Biogeochemical Province in Transition	- Collect various biological and bio-optical observations to address the role of calcifiers in the Arctic Ocean.	**Measurements of coccolithophore/ phytoplankton abundance.**	Western Arctic Ocean	June and July of 2011	Not Applicable, involves direct biological samplings along km-scale transects	Daily	- Fisheries regulations - Ocean acidification mitigation - Global carbon budget calculations - Coastal land management	NOAA, EPA, Global Carbon Project (GCP), NASA
Behrenfeld-01 [2010, continued beyond 2012] Characterizing the Phytoplankton Component of Oceanic Particle Assemblages	- Develop methodology using both ground-based and remote sensing data for measuring phytoplankton carbon biomass in the open ocean on a routine basis.	**Measurements of phytoplankton carbon.**	Tropical Pacific and Atlantic Oceans	2012	Not Applicable, involves direct biological samplings along km-scale transects	3-4 times a day when sampling	- Fisheries regulations - Ocean acidification mitigation - Global carbon budget calculations - Coastal land management	Any researcher who develops algorithms that relate optical properties to field data of ocean carbon stocks
Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	- Provide estimates of terrestrial biospheric carbon dioxide fluxes.	**Spatially gridded, temporally resolved estimates of terrestrial biospheric CO2 fluxes.**	Global	2010-2015	0.5°	Monthly	- Forest inventory - Land management	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	- Provide estimates of ocean surface carbon dioxide fluxes.	**Spatially gridded, temporally resolved estimates of oceanic CO2 fluxes.**	Global	2010-2015	18 km	Monthly and 3-hourly	- GHG emissions inventory - Watershed protection plans - Global carbon budget calculations - Ocean acidification mitigation	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	- Provide estimates of anthropogenic emissions from fossil fuel.	**Spatially gridded, temporally resolved estimates of fossil fuel emissions.**	Global	2010-2015	0.1°	Monthly and 3-hourly	- GHG emissions inventory - Global carbon budget calculations	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups

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Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	- Provide "top-down" estimates of carbon emissions due to biomass burning.	**Spatially gridded, temporally resolved estimates of biomass burning.**	Global	2010-2015	4° x 5°	Monthly	- Forest inventory - Land management - Global carbon budget calculations	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	Integrate observations across carbon cycle to attribute atmospheric CO2 distributions and trends to surface fluxes using an atmospheric top-down flux inversion.	**Spatially gridded, temporally resolved estimates of atmospherically constrained total CO2 fluxes and uncertainties**	Global	2010-2015	4° x 5°	Monthly	- GHG emissions inventory - Forest inventory - Land management - Watershed protection plans - Global carbon budget calculations - Ocean acidification mitigation	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Bowman-01 [2012] Continuation of the Carbon Monitoring System Flux Pilot Project	Provide posterior CO2 concentration data for evaluation and boundary condition to regional models	**Spatially gridded, temporally resolved estimates of vertically resolved CO2 concentrations.**	Global	2010-2015	4° x 5°	3-hourly	- GHG emissions inventory - Forest inventory - Land management - Watershed protection plans - Global carbon budget calculations - Ocean acidification mitigation	Group on Earth Observations (GEO), Regional Greenhouse Gas Initiative (RGGI), **CMS flux teams**, **EPA**, **NOAA** ***John Miller***, DOE Integrated Assessment (IA) and Climate and Earth System Modeling groups
Cook-B-01 [2012] Improving Forest Biomass Mapping Accuracy with Optical-LiDAR Data and Hierarchical Bayesian Spatial Models	- Quantify carbon stocks on local-scale at high spatial resolution for inventory and land management purposes.	**Forest biomass maps and associated uncertainties generated with hierarchical Bayesian spatial models.**	Penobscot Experimental Forest of Maine	2009-2012	10 – 20 m (plot-scale)	Every 5 years for Maine and sampling snapshots for other sites	- Forest inventory - Land management	**USFS**, private timber firms that are interested in productivity and biomass estimates, forest ecologists, and carbon cycle scientists who are interested in using Lidar to quantify biomass and structure.
Cook-B-01 [2012] Improving Forest Biomass Mapping Accuracy with Optical-LiDAR Data and Hierarchical Bayesian Spatial Models	- Quantify carbon stocks on local-scale at high spatial resolution for inventory and land management purposes.	**Forest biomass estimation using individual tree crown information**	Smithsonian Environmental Research Center of Maryland and Sierra Nevada Mountains (Teakettle) of California	2008-2012	Greater than or equal to 1 m (tree-scale)	Single point time observation	- Forest inventory - Land management	**USFS**, private timber firms that are interested in productivity and biomass estimates, forest ecologists, and carbon cycle scientists who are interested in using Lidar to quantify biomass and structure.
Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling.	**Canopy height and forest/non-forest maps.**	Maryland (all 24 counties)	Variable based on Lidar acquisition dates (2004-2012)	1 m and 30 m	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling.	**Aboveground biomass with associated uncertainty maps.**	Maryland (all 24 counties) and Addison County of Vermont	Variable based on Lidar acquisition dates (2004-2012)	30 m	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling.	**Prognostic ecosystem model (ED) based maps of carbon stocks and flux.**	Maryland (all 24 counties)	Updates forthcoming	90 m	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling.	**ED based maps of carbon sequestration potential.**	Maryland (all 24 counties)	Variable based on Lidar acquisition dates (2004-2012)	90 m	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products

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Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Develop a framework for estimating local-scale, high-resolution carbon stocks and future carbon sequestration potential using remote sensing and ecosystem modeling.	**Single photon Lidar canopy height and derived biomass maps.**	Only Garrett County of Maryland	Updates forthcoming	Canopy height at 1m and biomass at 30 m	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products
Dubayah-03 [2012] High Resolution Carbon Monitoring and Modeling: A CMS Phase 2 Study	- Provide an easy-to-access platform for obtaining data products.	**Web-based data visualization and query system.**	N/A	N/A	N/A	N/A	- Land management - Forest inventory	**Maryland Department of Natural Resources (DNR) Forest Service**, DOE, EPA, private landowners, **county GIS departments**, national and global entities that want to validate top down products
French-04 [2012] Development of Regional Fire Emissions Products for NASA's Carbon Monitoring System using the Wildland Fire Emissions Information System	- Provide estimates of wildland fire emissions with assessment of uncertainty. Documentation of the model and some improvements to include more dynamic input data.	**Maps of emissions from wildland fires. Emissions include CO2, CO, CH4, NMHC, PM2.5, PM10, and total carbon.**	CONUS and Alaska	2001-2013	1 km	Monthly	- Fire management - Forest inventory - Land management - Air quality protection	**EPA**, **USFS**, BLM, carbon accounting researchers, state agencies that prescribe burning and/or monitor air quality
Healey-01 [2012] A Global Forest Biomass Inventory Based upon GLAS Lidar Data	- Provide global country-level estimates of mean aboveground forest biomass per hectare in support of the 2015 UN Food and Agriculture Association Forest Resources Assessment.	**Statistical estimates -- derived consistently across countries and with well-defined confidence intervals -- of country-level mean forest biomass values and mean canopy height.**	Global	2005	N/A	N/A	- MRV, REDD+ - Forest inventory - Land management	**UN Food and Agriculture Organization (FAO)**, **USFS**, **SilvaCarbon**, and any country that needs the baseline data in order to improve its forest inventory system
Healey-01 [2012] A Global Forest Biomass Inventory Based upon GLAS Lidar Data	- Quantify uncertainties.	**Associated standard errors.**	Global	2005	N/A	N/A	- MRV, REDD+ - Forest inventory - Land management	**UN Food and Agriculture Organization (FAO)**, **USFS**, **SilvaCarbon**, and any country that needs the baseline data in order to improve its forest inventory system
Houghton-02 [2012] Spatially Explicit Sources and Sinks of Carbon from Deforestation, Reforestation, Growth and Degradation in the Tropics: Development of a Method and a 10 Year Data Set 2000-2010	- Develop methodology using satellite data for estimating gross and net carbon fluxes from deforestation, reforestation, growth, and degradation of tropical forests.	**TBD. Maps of gross and net carbon fluxes in the tropical forests due to deforestation, reforestation, growth, and degradation.**	Global Tropics	2000-2012	500 m	Annually	- MRV, REDD+ - Forest inventory - Land management - Forest inventory - Global carbon budget calculations	Developing countries who are seeking to reduce emissions in the tropics (Brazil, Indonesia), Brazilian National Institute for Space Research (INPE), Indonesia National Aerospace Institute (LAPAN), FAO, USAID, **GCP**
Huntzinger-01 [2012] Reduction in Bottom-Up Land Surface CO2 Flux Uncertainty in NASA's Carbon Monitoring System Flux Project through Systematic Multi-Model Evaluation and Infrastructure Development	- Provide improved land-atmosphere input products to the CMS FPP using the multi-model ensemble from MsTMIP.	**New prior land flux estimates, and their associated uncertainty, for CMS and other atmospheric CO2 inversions.**	Global	2009-2010	2° x 2.5°	Sub-daily	- GHG emissions inventory - Global carbon budget calculations - Land management	Process-based and inversion modeling communities participating in **MsTMIP**, **NASA CMS**, and elsewhere, IPCC Task Force on National Greenhouse Gas Inventories (IPCC TFI), GEO, USFS

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Huntzinger-01 [2012] Reduction in Bottom-Up Land Surface CO2 Flux Uncertainty in NASA's Carbon Monitoring System Flux Project through Systematic Multi-Model Evaluation and Infrastructure Development	- Develop the technical infrastructure of a carbon monitoring system to handle an integrated multiple land surface models system for operational use.	**Updated estimates of terrestrial net CO2 fluxes inferred from the CMS inversion and informed by these new land flux priors.**	Global	2009-2010	2° x 2.5°	Sub-daily	- GHG emissions inventory - Global carbon budget calculations - Land management	Process-based and inversion modeling communities participating in **MsTMIP**, **NASA CMS**, and elsewhere, IPCC Task Force on National Greenhouse Gas Inventories (IPCC TFI), GEO, USFS
Huntzinger-01 [2012] Reduction in Bottom-Up Land Surface CO2 Flux Uncertainty in NASA's Carbon Monitoring System Flux Project through Systematic Multi-Model Evaluation and Infrastructure Development	- Evaluate the consistency of MsTMIP model estimates with atmospheric CO2 observations, providing an additional benchmark of land-atmosphere model performance.	**Atmospheric CO2 signals generated from 15 terrestrial biospheric models.**	Global	2009-2010	2° x 2.5°	Sub-daily	- GHG emissions inventory - Global carbon budget calculations - Land management	Process-based and inversion modeling communities participating in **MsTMIP**, **NASA CMS**, and elsewhere, IPCC Task Force on National Greenhouse Gas Inventories (IPCC TFI), GEO, USFS
Jacob-01 [2012] Use of GOSAT, TES, and Suborbital Observations to Constrain North American Methane Emissions in the Carbon Monitoring System	- Develop a four-dimensional variational (4D-var) inverse modeling capability for methane emissions in North America using satellite (GOSAT, TES), aircraft (CalNex, HIPPO, NOAA/CCGG), and ground-based (TCCON, NOAA/CCGG) data.	**Estimates of methane emission fluxes.**	North America	2009 - present	1/2° x 2/3° (~50km x 50km)	Monthly	- Fire management - Air quality protection - GHG emissions inventory - Land management	Air quality agencies at both state and national levels (e.g. **EPA, Iowa Department of Natural Resources**), industry groups (e.g. **American Petroleum Institute**), US State Department
Kennedy-01 [2012] Integrating and Expanding a Regional Carbon Monitoring System into the NASA CMS	- Create a forest carbon monitoring system using Landsat, airborne Lidar, and field plot data for evaluation of other CMS biomass products. - Test the carbon monitoring system (originally developed in western forests) in eastern U.S. forests.	**Forest biomass maps.**	Washington, Oregon, and California	1990-2010	30 m	Annually	- Fire management - Forest inventory - Land management - Invasive species - Air quality protection	**USFS**, Oregon Department of Forestry, Oregon Department of Fish and Wildlife, Washington State Department of Natural Resources, California Department of Forestry and Fire Protection, California Clean Air Resources Board
Kennedy-01 [2012] Integrating and Expanding a Regional Carbon Monitoring System into the NASA CMS	- Test the carbon monitoring system (originally developed in western forests) in eastern U.S. forests.	**Maps of forest disturbance by agent, severity, and timing.**	Harvard Forest and environs (Massachusetts), Savanna River Forest and environs (South Carolina & Georgia)	1990-2010	30 m	Annually	- Fire management - Forest inventory - Land management - Invasive species - Air quality protection	**USFS**, Oregon Department of Forestry, Oregon Department of Fish and Wildlife, Washington State Department of Natural Resources, California Department of Forestry and Fire Protection, California Clean Air Resources Board
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Vegetation cover classes (reconstituted from National Land Cover Database, NLCD)**	Interior Alaska	2001-2010	60 m	Single time	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Topography (elevation, slope, aspect)**	Interior Alaska	2001-2010	60 m	Single time	- Fire management - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Drainage category**	Interior Alaska	2001-2010	60 m	Single time	- Fire management - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)

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Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Year of previous fire event**	Interior Alaska	2001-2010	60 m	Single time	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Year of fire during the 2001-2010 era**	Interior Alaska	2001-2010	60 m	Single time	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Burned area perimeter**	Interior Alaska	2001-2010	60 m	Annually	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Burned/unburned areas within perimeter**	Interior Alaska	2001-2010	60 m	Annually	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Day of burning**	Interior Alaska	2001-2010	60 m	Annually	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Meteorological parameters (temperature, relative humidity, wind, precipitation)**	Interior Alaska	2001-2010	60 m	Daily, end of May through beginning of September for the years of 2001 through 2010	- Fire management - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Fire weather indices (full suite of Canadian Fire Danger Rating System, CFDRS)**	Interior Alaska	2001-2010	60 m	Daily, end of May through beginning of September for the years of 2001 through 2010	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**TEM-generated carbon content of aboveground biomass**	Interior Alaska	2001-2010	1km	Year 2000	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**TEM-generated carbon content of down woody debris-layer**	Interior Alaska	2001-2010	1km	Year 2000	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**TEM-generated organic soil carbon content**	Interior Alaska	2001-2010	1km	Year 2000	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Loboda-02 [2012] The Forest Disturbance Carbon Tracking System: A CMS Phase 2 Study	- Develop a database that provides estimates of changes in carbon stocks from fires in the boreal region of Alaska for 2001-2010.	**Modeled carbon loss from wildfire events**	Interior Alaska	2001-2010	1km	Year 2000	- Fire management - Forest inventory - Land management	Federal land management agencies in Alaska (i.e. USFS, BLM, Fish and Wildlife Service, Department of Defense, National Park Service, and EPA)
Lohrenz-04 [2012] Development of Observational Products and Coupled Models of Land-Ocean-Atmospheric Fluxes in the Mississippi River Watershed and Gulf of Mexico in Support of	- Develop georeferenced products that quantify land to ocean exchanges of carbon using a combination of models and remotely-sensed and in situ observations.	**Land-ocean fluxes of carbon and nitrogen.**	Mississippi River Watershed and Gulf of Mexico, including continental margins of Florida and the South Atlantic Bight	1904-1910, 2004-2010	5 arc-minutes	Monthly	- Land management - Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, US Global Change Research Program, **CMS terrestrial flux teams**

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Carbon Monitoring								
Lohrenz-04 [2012] Development of Observational Products and Coupled Models of Land-Ocean-Atmospheric Fluxes in the Mississippi River Watershed and Gulf of Mexico in Support of Carbon Monitoring	- Develop georeferenced products that quantify air to sea exchanges of carbon using a combination of models and remotely-sensed and in situ observations.	**Ocean-atmosphere fluxes of carbon dioxide.**	Mississippi River Watershed and Gulf of Mexico, including continental margins of Florida and the South Atlantic Bight	1904-1910, 2004-2010	5 km	Monthly	- Land management - Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, US Global Change Research Program, **CMS terrestrial flux teams**
Lohrenz-04 [2012] Development of Observational Products and Coupled Models of Land-Ocean-Atmospheric Fluxes in the Mississippi River Watershed and Gulf of Mexico in Support of Carbon Monitoring	- Develop georeferenced products that quantify coastal to open ocean exchanges of carbon using a combination of models and remotely-sensed and in situ observations.	**Continental shelf-ocean exchanges of carbon and nitrogen.**	Mississippi River Watershed and Gulf of Mexico, including continental margins of Florida and the South Atlantic Bight	1904-1910, 2004-2010	5 km	Monthly	- Land management - Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, US Global Change Research Program, **CMS terrestrial flux teams**
Lohrenz-04 [2012] Development of Observational Products and Coupled Models of Land-Ocean-Atmospheric Fluxes in the Mississippi River Watershed and Gulf of Mexico in Support of Carbon Monitoring	- Develop georeferenced products that quantify any associated uncertainties with land to ocean, air to sea, and coastal to open ocean exchanges of carbon using a combination of models and remotely-sensed and in situ observations.	**Associated uncertainties.**	Mississippi River Watershed and Gulf of Mexico, including continental margins of Florida and the South Atlantic Bight	1904-1910, 2004-2010	N/A	N/A	- Land management - Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	EPA (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force), NOAA, USGS, US Global Change Research Program, **CMS terrestrial flux teams**
Miller-J-01 [2012] In Situ CO2-Based Evaluation of the Carbon Monitoring System Flux Product	- Evaluate the CMS Bowman-01 flux product by using NOAA's in situ CO2 data.	**A comparative evaluation of observed CO2 fluxes and a posteriori modeled CO2 fluxes from a CMS Bowman-01 flux product.**	Global	2009-2011	Variable	Weekly to Monthly	- MRV, REDD+ - GHG emissions inventory - Land management	**CMS Bowman-01 Flux Product team**
Pawson-01 [2012] GEOS-CARB: A Framework for Monitoring Carbon Concentrations and Fluxes	- Develop a comprehensive ("big-picture") framework that incorporates all anthropogenic, terrestrial, oceanic, and atmospheric fluxes.	**Estimates of net terrestrial biospheric CO2 fluxes, including biomass burning.**	Global	2003-2013	0.5° x 0.5°	Monthly	- GHG emissions inventory - Global carbon budget calculations - Land management	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Pawson-01 [2012] GEOS-CARB: A Framework for Monitoring Carbon Concentrations and Fluxes	- Develop a comprehensive ("big-picture") framework that incorporates all anthropogenic, terrestrial, oceanic, and atmospheric fluxes.	**Estimates of net oceanic CO2 fluxes.**	Global	1998-2013	0.5° x 0.5°	Monthly	- Global carbon budget calculations - Ocean acidification mitigation	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Pawson-01 [2012] GEOS-CARB: A Framework for Monitoring Carbon Concentrations and Fluxes	- Examine the propagation of uncertainties in surface fluxes into atmospheric concentrations in addition to the impacts of transport uncertainty on atmospheric CO2 distributions.	**Uncertainties associated with terrestrial and oceanic fluxes.**	Global	2003-2013 for terrestrial 1998-2013 for oceanic	0.5° x 0.5°	Monthly	- GHG emissions inventory - Global carbon budget calculations - Land management - Ocean acidification mitigation	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Pawson-01 [2012] GEOS-CARB: A Framework for Monitoring Carbon Concentrations and Fluxes	- Examine the propagation of uncertainties in surface fluxes into atmospheric concentrations in addition to the impacts of transport uncertainty on atmospheric CO2 distributions.	**Assimilated 3D atmospheric fields of CO2 concentrations.**	Global	2003-2016	0.5° x 0.5°	Daily	- Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.

Project ID / Award Year / Title	Objectives	Products	Spatial Extent	Time Period	Spatial Resolution	Temporal Frequency	Application Areas	Potential Users
Pawson-01 [2012] GEOS-CARB: A Framework for Monitoring Carbon Concentrations and Fluxes	- Examine the propagation of uncertainties in surface fluxes into atmospheric concentrations in addition to the impacts of transport uncertainty on atmospheric CO2 distributions.	**Characterization of size and location of regions that impact the ACOS observations.**	Global	Updates forthcoming	Updates forthcoming	Updates forthcoming	- Global carbon budget calculations	**CMS flux teams**, USGS, EPA, NOAA, GCP, and others who want to run carbon cycle models.
Saatchi-02 [2012] Prototyping MRV Systems Based on Systematic and Spatial Estimates of Carbon Stock and Stock Changes of Forestlands	- Spatially represent all carbon pools (ABG, BGB, CWD, forest floor, soil) in forestlands of the United States by integrating remote sensing and GIS techniques with the US forest inventory data.	**Maps of all forest carbon stocks (aboveground biomass, belowground biomass, coarse woody debris, forest floor, and soil)**	CONUS (all carbon pools) and Alaska (only AGB and BGB)	2000-2010	100 m	Forest cover – 2000, 2005, 2010; Aboveground biomass – 2000, 2005; Other carbon pools – 2000, 2005	- MRV - Forest inventory - Land management	USGS**, USFS,** EPA**, President's Interagency Climate Change Adaptation Task Force**
Saatchi-02 [2012] Prototyping MRV Systems Based on Systematic and Spatial Estimates of Carbon Stock and Stock Changes of Forestlands	- Develop a systematic and spatially refined estimate of net forest carbon stock changes (fluxes) between 2000 and 2010 that can be compared to net fluxes derived using the extensive network of FIA plots. - Develop and prototype an MRV system that tracks emissions and removals of carbon separately to be used for international policy applications with the capability of providing national or sub-national scale baselines of gross and net carbon fluxes and uncertainty, and test its applicability to the State of Alaska, where a GHG inventory is sorely lacking	**Maps of net carbon stock changes (fluxes).**	CONUS and Alaska	2000-2010	100 m	2000-2005, 2005-2010	- MRV - Forest inventory - Land management	USGS**, USFS,** EPA**, President's Interagency Climate Change Adaptation Task Force**
Saatchi-02 [2012] Prototyping MRV Systems Based on Systematic and Spatial Estimates of Carbon Stock and Stock Changes of Forestlands	Updates forthcoming	**Disturbance layers (time since disturbance, recovery rate, disturbance severity)**	CONUS and Alaska	Updates forthcoming	Updates forthcoming	Updates forthcoming	- MRV - Forest inventory - Land management	USGS**, USFS,** EPA**, President's Interagency Climate Change Adaptation Task Force**
Shuchman-01 [2012] Development of New Regional Carbon Monitoring Products for the Great Lakes Using Satellite Remote Sensing Data	- Develop new satellite-derived primary production estimate for Great Lakes. - Conduct historical analysis of primary production and key input parameters (i.e., chlorophyll, KdPAR, and PAR).	**Lake-wide primary production estimates for all five Great Lakes in the U.S.**	Laurentian Great Lakes	2002-2014	1 km	Annually – time series for Lakes Michigan, Superior, and Huron: 2002-2014 Monthly – seasonal analysis for upper three Lakes: only 2011	- Watershed protection plans - Global carbon budget calculations - Coastal land management	**Michigan Department of Environmental Quality**; **Great Lakes Observing System (GLOS)**; **US National Park Service; USGS; NOAA**; US Coast Guard; **EPA** Regions 2, 3, & 5; Illinois, Indiana, Michigan, Pennsylvania, New York, Wisconsin, Minnesota, & Ohio Departments of Natural Resources or equivalent agencies; Environment Canada; Great Lakes Fishery Commission
Verdy-01 [2012] Towards a 4D-Var Approach for Estimation of Air-Sea Carbon Dioxide Fluxes	- Develop methodology for 4D-Var data assimilation in a coupled physical-biogeochemical ocean model in order to improve air-sea CO2 flux estimates.	**Estimates of the biogeochemical state of the ocean: carbonate system (dissolved inorganic carbon, alkalinity, pH, pCO2), air-sea CO2 fluxes, nutrients,**	California coastal ocean	2007-2010	7 km	Monthly and hourly	- Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	NOAA, EPA, White House Council on Environmental Quality, any oceanographer or modeler who needs to know the global ocean 3-D distribution of carbon system parameters and tracers that are not commonly cataloged by National Oceanographic Data Center

Project ID / Award Year / Title	Objectives	Products	Spatial Extent	Time Period	Spatial Resolution	Temporal Frequency	Application Areas	Potential Users
		biological productivity						
Verdy-01 [2012] Towards a 4D-Var Approach for Estimation of Air-Sea Carbon Dioxide Fluxes	- Compile a calibrated dataset of in-situ ocean observations needed to constrain a global 4D-Var biogeochemical model.	**Global Ocean Data Analysis Project version 2 (GLODAPv2), a comprehensive data product of ocean carbon and biogeochemistry observations.**	Global	1973-2013	1°	N/A (climatology)	- Global carbon budget calculations - Watershed protection plans - Ocean acidification mitigation	NOAA, EPA, White House Council on Environmental Quality, any oceanographer or modeler who needs to know the global ocean 3-D distribution of carbon system parameters and tracers that are not commonly cataloged by National Oceanographic Data Center
West-03 [2012] Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study	- Develop a global gridded dataset for cropland carbon fluxes using global- and country-level inventory data on crop yields.	**Gridded data carbon uptake by crop. NPP (C per year)**	Global	2005-2010	0.05°	Annually	- GHG emissions inventory - Land management	**EPA, USDA Farm Service Agency**, **CMS flux teams**, United Nations Environment Programme – Global Environmental Facility, UNFCCC, FAO, NGOs: World Wildlife Fund, The Nature Conservancy, & Natural Resource Defense Council
West-03 [2012] Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study	- Develop a global gridded dataset for cropland carbon fluxes using global- and country-level inventory data on crop yields.	**Carbon release by livestock.**	Global	2005-2010	0.05°	Annually	- GHG emissions inventory - Land management	**EPA, USDA Farm Service Agency**, **CMS flux teams**, United Nations Environment Programme – Global Environmental Facility, UNFCCC, FAO, NGOs: World Wildlife Fund, The Nature Conservancy, & Natural Resource Defense Council
West-03 [2012] Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study	- Develop a global gridded dataset for cropland carbon fluxes using global- and country-level inventory data on crop yields.	**Carbon release by human.**	Global	2005-2010	0.05°	Annually	- GHG emissions inventory - Land management	**EPA, USDA Farm Service Agency**, **CMS flux teams**, United Nations Environment Programme – Global Environmental Facility, UNFCCC, FAO, NGOs: World Wildlife Fund, The Nature Conservancy, & Natural Resource Defense Council
West-03 [2012] Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study	- Develop a global gridded dataset for cropland carbon fluxes using global- and country-level inventory data on crop yields.	**Estimates of carbon fluxes for agricultural lands: combination of uptake by crop, release by livestock, and release by human.**	Global	2005-2010	0.05°	Annually	- GHG emissions inventory - Land management	**EPA, USDA Farm Service Agency**, **CMS flux teams**, United Nations Environment Programme – Global Environmental Facility, UNFCCC, FAO, NGOs: World Wildlife Fund, The Nature Conservancy, & Natural Resource Defense Council
West-03 [2012] Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study	- Provide land cover projections that can be used to derive spatially explicit estimates of potential shifts in croplands, grasslands, shrub lands, and forest lands in various future climate scenarios.	**Land cover projections (5.6-km) from GCAM v3.1 under 3 different scenarios: 1) no explicit climate mitigation efforts 2) low emission with a mid-century peak in radiative forcing 3) stabilized radiative forcing at 4.5 W/m2.**	CONUS	2005-2095	0.05° (~5.6 km)	Annually	- GHG emissions inventory - Land management	carbon cycle scientists, those interested in climate change and land cover change

Key: Fact Sheet Categories

Category	Explanation
Award Year	The year the funding was granted
Project ID	Principal Investigator's last name and project #
Objectives	Goals that the project seeks to attain by developing data and products
Science Theme	Type of data and products, according to components of carbon cycle research that are most relevant: Global Flux, Ocean-Atmosphere Flux, Land-Atmosphere Flux, Land-Ocean Flux, Land Biomass, Ocean Biomass, Lake Biomass, MRV, and Decision Support
Products Keywords	Keywords that will help stakeholders identify data and products appropriate to their needs. See below for a table that explains each product keyword.
Data Products	A description of output data and products that will be publicly available upon completion of the project
Spatial Extent	The geographical area that the data and products cover
Coordinates	Coordinates can be approximate. They can be the center of Spatial Extent or study sites. Shape files are welcome.
Time Period	The time period that the data and products cover
Spatial Resolution	Finest spatial resolution of data and products
Temporal Frequency	Time intervals of data products
Input Data Products	Any satellite, airborne, field, and modeled data products used. If airborne Lidar data was used, please indicate where, when, which instruments, and how much data (area, dimensions, or number and length of lines).
Algorithm/Models Used	Any algorithm or models used to develop data and products
Evaluation	Any efforts to evaluate the accuracy, robustness, and/or performance of data and products
Intercomparison Efforts/Gaps	Any key intercomparison effort(s) that have been undertaken or gaps where future intercomparison efforts are warranted
Uncertainty Estimates	Plans to quantify data uncertainty, if any
Uncertainty Categories	1. Ensemble (e.g. stochastic), 2. Deterministic, 3. Model-Data Comparison, 4. Model-Model Comparison, and/or 5. Data-Data Comparison
Application Areas	Areas with policy or societally relevant decision processes, which may benefit from the usage of data and products
Potential Users	Possible end users of data and products once fully developed. Bold indicates existing communication between the CMS product developers and the end users. Specific points of contact for these end users are listed between asterisks.
Application Readiness Level (ARL)	The NASA index that assesses applications potential of data and products in operational settings. Detailed explanation. Principal Investigators specified the ARLs of their own projects
Future Developments	Future plans to engage stakeholders, share data and products, and raise awareness of the product development efforts
Limitations	Any shortcoming of data and products that users must be aware of
Date When Data/Product Available	The date (MM/DD/YY – if possible) on which data and products will be made publicly available
Data Server URL	The URL address where a user may access data and products
Metadata URL	The URL address where a user may access metadata
Archived Data Citation	Citation of data and product(s) that users can include in their references
Publications	A list of journal publications that directly resulted from CMS funding

Acronyms List

ACOS	Atmospheric CO2 Observations from Space Task
AGB	Aboveground biomass
ARL	NASA Application Readiness Level
BGB	Belowground biomass
BLM	U.S. Bureau of Land Management
CA-AB32	California Assembly Bill 32: Global Warming Solutions Act
CAA	U.S. Clean Air Act
CAP	President Obama's Climate Action Plan of 2013
CarboNA	Carbon North America, formerly the Joint North American Carbon Program (JNACP)
CH4	Methane
CO	Carbon monoxide
CO2	Carbon dioxide
CONUS	Contiguous United States, 48 states below Canada and above Mexico
CMS	NASA Carbon Monitoring System Initiative
CWA	U.S. Clean Water Act
DOE	U.S. Department of Energy
Doha/Kyoto	Doha Amendment to the Kyoto Protocol
EPA	U.S. Environmental Protection Agency
FAO	Food and Agriculture Organization of United Nations
FIA	Forest Inventory and Analysis of the U.S. Forest Service
FLPMA	U.S. Federal Land Policy and Management Act
FORAM	U.S. Federal Ocean Acidification Research and Monitoring Act
FPP	Carbon Monitoring System Flux Pilot Project
GCP	Global Carbon Project
GEO	Group on Earth Observations
GO-SHIP	Global Ocean Ship-based Hydrographic Investigations Program
GOSAT	Greenhouse gases Observing SATellite
ICESat-2	Ice, Cloud, and land Elevation Satellite-2
INCAS	Indonesian National Carbon Accounting System
IOCCP	International Ocean Carbon Coordination Project
IPCC	Intergovernmental Panel on Climate Change

Acronyms List

IPCC GPG	IPCC Good Practice Guide for Land Use, Land-Use Change, and Forestry
IPCC TFI	IPCC Task Force on National Greenhouse Gas Inventories
LAPAN	Indonesia National Aerospace Institute
MRP	Mega Rice Project
MRV	UN-REDD+ Measurement, Reporting, and Verification of carbon emissions reductions
MsTMIP	Multi-Scale Synthesis and Terrestrial Model Intercomparison Project
NACP	North American Carbon Program
NALS	North American Leaders' Declaration on Climate Change and Clean Energy
NASA	U.S. National Aeronautics and Space Administration
NFMS	National Forest Monitoring System
NGHGI	National Greenhouse Gas Inventory
NMHC	Non-methane hydrocarbon
NOAA	U.S. National Oceanic and Atmospheric Administration
OCO-2	Orbiting Carbon Observatory-2
PM2.5 (or PM10)	Particulate matter sized 2.5 (10) micrometers or smaller
REDD+	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
RGGI	U.S. Regional Greenhouse Gas Initiative
UNFCCC	United Nations Framework Convention on Climate Change
US-Indonesia Partnership	U.S.-Indonesia Partnership on Climate Change and Clean Energy
US-Mexico Bilateral	U.S.-Mexico Bilateral Framework on Clean Energy and Climate Change
USAID	U.S. Agency for International Development
USCCSP	U.S. Carbon Cycle Science Program
USDA	U.S. Department of Agriculture
USFS	U.S. Department of Agriculture Forest Service
USGS	U.S. Geological Survey
XCO2 or XCH4	Column-averaged dry air mole fractions of atmospheric CO2 or CH4